# Frequently Asked Questions Concerning
## Weather Surveillance Radar-1988 Doppler (WSR-88D) Level II Data
Updated 11/1/04

**What Are WSR-88D Level II Data?**
Response: Level II data contain the reflectivity, radial velocity, and spectrum width data produced by the WSR-88D. They contain the data from all scans of the radar, at 256 data levels, and at the highest spatial resolution of the radar ($1^o$ x 1km for reflectivity, $1^o$ x 0.25km for radial velocity, and $1^o$ x 0.25km for spectrum width).

**How Do Level II Data Differ From Level III Data?**
Response: Level II data are the input to the Radar Product Generator (RPG). The Level III data and other products are output of the RPG meteorological algorithms or the display of the data mapped to a polar coordinate grid. The Level II data have 256 data levels while nearly all Level III products have 16 data levels. The Level II data contain data from all scans while the Level III data displays data from the lowest four scans, at most, though the algorithms can consider data collected at all scans.

**How Are The Level II Data Prepared For Distribution?**
Response: The Level II data sent to users differs from that used by the Radar Product Generator in the following ways: (1) The data are compressed using BZIP2 software, (2) A header record containing metadata is added at the start of each volume scan, and (3) Unidata Local Data Manager software is used to route the data.

**What Is The Path Of The Level II Data To The User?**
Response: The schematic at the following URL outlines the data flow: http://www.osf.noaa.gov/NWS_Level_2/Level2_FOC.pdf. What is not depicted is the data flow from the four designated top-tier sites to connecting users.

**What Is The Latency Of Real-Time Level II Data?**
Response: The latency of Level II data traveling from radar sites to users connected to top-tier sites is usually less than 5s. The radars "bundle" 100 radials of data at a time for transmission, which can take up to 25s, based on the scanning strategy of the radar. Thus the data are generally available to users within 30s of the time the data are processed by a radar's receiver.

**What Is the Expected Reliability Of Delivery Of Real-Time Level II Data?**
Response: The NWS goal is 95% of the time when the radars are operating. The radar availability goal is 96%. These are annual goals.

**Should I Contact Radar Sites If The Level II Data Is Not Flowing?**
Response: Please do not contact the sites. This can cause a disruption for the staff at the radar site if they are responding to inquiries about Level II data.

**What Can Cause The Level II Data To Stop?**
Response: There are several "single points of failure" in the Level II data stream. While there are many failure points, fortunately the hardware/software/communication links are very reliable.

**Can I Ask A Radar Site To Change Their Mode Of Operation?**
Response: No. The sites operate the radars to meet the primary mission needs of the NEXRAD agencies and will not change the operating strategy based on external requests.

**How Can I Determine If A Given Radar Is Operating If The Level II Data Flow Stops?**
Response: There are a couple of approaches. The NWS maintains a page, updated each minute, which depicts the status of the flow of product/Level III data to the NWS central server of radar products: http://weather.noaa.gov/monitor/radar/. This assumes the Advanced Weather Interactive Processor System (AWIPS) at the site and the communications link to the NWS central server are operating – the reliability of this link is very high. In addition, one can check the many sites on the Internet displaying WSR-88D imagery (e.g., http://weather.noaa.gov/radar/national.html) to see if the data from the site is current and updating.

**How Can I Obtain Level II Data In Real-Time?**
Response: Since there is no restriction on the use or redistribution of the data there are many locations where you can receive Level II data, including private vendors. The NWS does not track where the data are flowing once they have reached the designated top tiers. The top tier sites and their point of contact are listed below:

- Education and Research Consortium of the Western Carolinas (ERC), Dr. Max Lennon, 828-350-2010, maxlennon@ercwc.org
- Purdue University, Professor Matthew Huber, 765-494-3258, huberm@purdue.edu
- University of Oklahoma, Professor Kelvin K. Droegemeier, 405-325-0453, kkd@ou.edu

**How Can I Obtain Archive Level II Data?**
Response: The data are archived at the National Climatic Data Center (NCDC). Check the following web site for the inventory of data and for requesting the data via FTP: http://has.ncdc.noaa.gov/plclimprod/plsql/HAS.FileAppSelect?datasetname=6500.

**How Do I Learn How To Read Or Display Level II Data?**
Response: The NWS does not provide software for reading or displaying Level II data. However, the following resources are available to Level II users:

1. The NEXRAD Radar Operations Center provides technical documentation, called an interface control document (ICD), for Level II data. This ICD can be obtained at: http://www.roc.noaa.gov/ssb/cm/icd_downloads.asp. Request "2620010A ICD for Archive II/User."
2. The NWS provides the Radar Product Generator software and some display software at: ftp://ftp.nws.noaa.gov/software/88D_CODE/. This software, which runs on a Linux

platform, is provided without warranty or follow on support.
3. The National Climatic Data Center (NCDC) provides software that uses Level II data without warranty or follow on support at:
http://www.ncdc.noaa.gov/oa/radar/radarproducts.html#SOFTWARE

**What Are The Scan Strategies Of The WSR-88D?**
Response: During operations, the antenna is controlled by automatic scanning programs. Volume coverage patterns (VCPs) are matched to an operational mode to optimize product generation for given meteorological situations. (From FMH-11, Part C)

VCPs 11 and 21. These VCPs are used in the Precipitation Mode to better sample the vertical structure of convective weather echoes and to provide better temporal resolution. VCP 11 provides better vertical sampling of weather echoes near the antenna than VCP 21 and is usually preferred in situations where convective precipitation is within 60 nmi of the antenna. VCP21 is the default VCP used during precipitation events, though operators can manually change the VCP being used.

VCP 12. This VCP has the same number of elevation angles as VCP 11. However, denser vertical sampling at lower elevation angles will provide better vertical definition of storms, improve detection capability of radars impacted by terrain blockage for better rainfall and snowfall estimates, result in more storms being identified, and provide quicker updates.

VCPs 31 and 32. Both of these VCPs are used in the Clear-Air Mode to optimize the sensitivity of the WSR-88D. Within the pair, however, VCP 31 (long pulse) provides a better signal-to-noise ratio permitting lower reflectivity returns to be detected, while VCP 32 (short pulse) provides a higher unambiguous velocity.

VCP 121. This VCP has the same elevation angles as VCP 21, but more scans. This VCP implements the multi-pulse repetition frequency (PRF) dealiasing algorithm (MPDA) which helps mitigate range/velocity aliasing (the Doppler Dilemma).

TABLE 4-1
VOLUME COVERAGE PATTERN DESCRIPTION

| Volume Coverage Pattern Number | Number Of Azimuthal Scans | Number Of Different Elevation Angles | Time To Complete (Minutes) |
|---|---|---|---|
| 11 | 16 | 14 | 5 |
| 12 | 17 | 14 | 4.1 |
| 21 | 11 | 9 | 6 |
| 31 | 7 | 5 | 10 |
| 32 | 7 | 5 | 10 |

| 121 | 20 | 9 | 5 |
|-----|----|----|----|

## How Much Level II Data Does A WSR-88D Produce?

Response:  The data rate depends on the scanning strategy of the radar, the amount and type of weather within the range of the radar, and the efficiency of the data compression (BZIP2). Below are the estimated data rates for the various WSR-88D scan strategies (observed maximum data flow rates per radar (compressed), the larger of observed or computed/estimated):

| | |
|---|---|
| VCP11 | 63 kbps |
| VCP12 | 77 kbps |
| VCP21 | 41 kbps |
| VCP31 | 15 kbps |
| VCP32 | 15 kbps |
| VCP121 | 77 kbps |

## Are There Additional References To Help Better Understand Level II Data And The WSR-88D?

Response:  The following references are available which may help:

1. Federal Meteorological Handbook No. 11 (FMH-11), Part A, System Concepts, Responsibilities, and Procedures.  Available at: http://www.ofcm.noaa.gov/fmh11/fmh11.htm.
2. Crum, T.D., and R.L. Alberty, 1993:  The WSR-88D and the WSR-88D operational support facility. *Bull. Amer. Meteor. Soc.*, **74**, 1669-1687.
3. Crum,  T.D., R.L. Alberty, and D.W. Burgess, 1993:  Recording, archiving, and using WSR-88D data. *Bull. Amer. Meteor. Soc.*, **74**, 645-653
4. Crum,  T.D., R.E. Saffle, and J.W. Wilson, 1998:  An update on the NEXRAD program and the future WSR-88D support to operations. *Weather and Forecasting*, 13, 253-262

## How Can I Request Additional Information About Level II Data?

Response:  If you have specific questions or comments in regard to this project, please contact the Radar Operations Center webmaster at:  http://www.roc.noaa.gov/Feedback/